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Enhancing Student Competence Through Visits to Karangmumus River School to Study Its Ecology Using the River Continuum Concept

[1]Ahmad Shiddiq Mulyanto*, [1]Merinda Margaret Kaunang, [1]Fenty Fauziah, [1]Fitriansyah, [1]Bun Yamin, [1]Muhammad Harry Rahmadi
[1]Universitas Muhammadiyah Kalimantan Timur, Indonesia

*Corresponding author
E-mail: ahmadkuha@gmail.com

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Abstract

Purpose: This study aims to enhance student's environmental awareness, particularly regarding river ecology, through an experiential learning approach. The primary activity in this research is a field visit by students to the Karangmumus River School, allowing them to compare theoretical knowledge learned in class with real-world conditions.

Method: The study employs a qualitative method with a descriptive approach. Data was collected through observations, interviews, and student reflections after the field visit.

Practical Application: The findings reveal that the visit significantly improved students' understanding of river conservation and the impact of human activities on river ecosystems. Furthermore, the activity motivated students to contribute to environmental preservation efforts. Thus, integrating classroom theory with field experiences effectively fostered environmental awareness among students.

Conclusion: This study shows that experiential learning through field visits to the Karangmumus River School significantly increases students' awareness of river ecology and environmental conservation.

Introduction

An ecosystem is an ecological system consisting of reciprocal relationships between living things and their environment, forming a unity that influences each other. In an ecosystem, each component has an important role in maintaining the balance of nature. One ecosystem that has a strategic role in human life is the river ecosystem. The river ecosystem not only provides water resources for domestic, industrial, and agricultural needs, but also becomes a habitat for various types of organisms that support biodiversity.

River ecology, as a branch of ecology, studies the interactions between organisms living in river ecosystems and their environmental factors. This includes physical, chemical, and biological aspects that shape river characteristics. However, river ecosystems often face pressure from human activities, such as pollution, excessive resource extraction, and changes in land use around river basins (DAS). This condition requires attention and awareness from various parties, including the younger generation, to maintain the sustainability of river ecosystem functions.

The River Continuum Concept (RCC) was first introduced by (Vannote et al., 1980). The original article containing this theory was published in the Canadian Journal of Fisheries and Aquatic Sciences, titled "The River Continuum Concept" (Vol. 37, pp. 130-137). This research provides a theoretical framework for understanding how physical, biological, and ecological gradients change along a river course, from headwaters to downstream, and how these changes affect the structure of organism communities and energy flows in river ecosystems. This concept is recognized as a milestone in river ecology due to its comprehensive evaluation of the structure and function of lotic ecosystems (Doretto et al., 2020)

Figure 1. Delivery of initial material about RCC before departure to the river headwaters.

The River Continuum Concept (RCC) explains that river ecosystems change longitudinally from upstream to downstream, especially in relation to the structure of biotic communities, energy dynamics, and processing of organic matter, (Cummins, 1974) added that the RCC explains how physical gradients, such as flow velocity and water depth, play an important role in shaping river ecosystem processes. These factors influence the distribution of organisms, patterns of ecosystem interactions, and energy dynamics that occur along the river course. (Allan, 1995) stated that the RCC provides insight into how human activities, such as pollution and river flow modification, affect the structure of biotic communities and overall ecosystem function. The scientific process generally proceeds slowly and steadily, but occasionally experiences periods of acceleration in growth and change, which Thomas Kuhn called "scientific revolutions" (Kuhn, 2021)

The River Continuum Concept (RCC) (Water et al., 1980) was published in the Canadian Journal of Fisheries and Aquatic Sciences 40 years ago. It integrated important theoretical foundations of the time, such as habitat pattern theory (Southwood, 1977) and entropy theory (Leopold, 1962). At the same time, it fundamentally changed the way research in river ecology was conducted. By proposing mechanistic relationships between environmental parameters, energy inputs, and biota composition, it prompted a shift in river ecology from a descriptive approach to a more predictive one (Minshall et al., 1985). A large body of evidence now exists in scientific literature and several studies have been conducted worldwide on the subject (Winterbourn et al., 1981); (Barmuta & Lake, 1982); (Minshall et al., 1983).

Figure 2. Group photo with the speakers and preparations for departure.

As part of efforts to increase environmental awareness among the younger generation, especially students, experiential learning can be an effective method. In this context, the students' visit to the Karangmumus River School was designed to connect the theories learned in class with the reality of river ecosystem conditions. The Karangmumus River School is an ideal location to explore river ecosystems directly, given its role as an environmental education center that focuses on river conservation.

Through this research, it is expected that students can understand the important role of river ecosystems in life and the impact of human behavior on their balance. In addition, this study aims to measure the effectiveness of experiential learning in increasing students' concern for the environment. Thus, the integration of theory and field experience is expected to create a generation that cares more about environmental sustainability, especially river ecosystems.

Method

This study uses a qualitative descriptive approach with a systematic research method to obtain valid and relevant data. The methods used are direct observation methods in the field to obtain primary data, sampling river water ecology, and focus group discussions.

Figure 3. Departure process from the boat base (downstream location).

In this activity students take turns riding the boat seeing in the downstream conditions of the river the water conditions are very polluted, due to human waste and industrial waste, the river walls have been concreted so that there is no water absorption, and there is no biodiversity around the river, This happens because there are no native varieties of the river, so direct exposure to sunlight causes algae to appear in large quantities. Light availability in open canopy locations influences algal growth and reproduction, and also affects eroding (Canning et al., 2019); (Wang, 2022).

The RCC also estimated that the relative abundance of predators decreased slightly along the river from upstream to downstream. (Masese et al., 2014) reported that predators dominated richness and biomass, respectively, in closed-canopy rivers. (Dalu et al., 2017) also reported that predators were relatively abundant in upland river areas. Sites with good riverbank quality presented higher abundances of several functional predator groups (Mesa, 2014)

Figure 4. The location is in the middle of the river, showing the condition of the river due to human activity.

In this activity, the boat has reached the middle of the journey, it can be seen that the condition of the river is still polluted by industrial waste, as well as human waste due to industrial activities and human settlements on the riverside, the condition of the water is also not very good. The cloudy color of the water is caused by organic particles carried from land to the river through rainwater or surface flow. This water is often used to irrigate gardens and rice fields around the river. (Gholizadeh & Heydarzadeh, 2020) stated that the open nature of the monitoring station, combined with the fact that much of the watershed drains agricultural land where particulate organic matter levels are typically high, ensures an adequate supply of FPOM. Based on research by (Masese et al., 2014), scraper abundance was higher in open canopy locations.

Figure 5. The location is in the middle of the river, indicating the condition of the river without any human activity.

This picture 5 shows the condition of the river that has begun to improve, marked by the clearing of the water so that the bottom of the river is clearly visible due to sunlight that can penetrate the surface of the river. The penetration of sunlight indicates that the river water is very clear. In this location, predators were found at the top of the food chain in the river, this happened because the riverbank area is still natural and has not been mixed with industrial or human activities, so the ecology is still maintained. The community structure in the upper reaches of rivers is largely shaped by riparian vegetation, which adds organic debris to the channel and shades the riverbed (Vimos-Lojano et al., 2017). Food webs in forest river ecosystems are typically driven by allochthonous organic inputs, especially leaf litter (Neres-Lima et al., 2017) resulting in the emergence of fish around the river. In rivers, leaf litter is easily washed, colonized, and decomposed by microorganisms, then consumed by shredders (Newman et al., 2015).

Macroinvertebrates rely on diverse food sources, including epilithic biofilms that develop on substrate surfaces, consumed primarily by scrapers. Shredders feed on coarse detritus, which largely comprises fallen leaves from riparian vegetation. Fine detritus, either deposited on the substrate or suspended in the water column, is utilized by foragers and filter feeders, respectively. Additionally, predators prey on live animals as their primary food source (Gholizadeh & Heydarzadeh, 2020).

Figure 6. The location is at the head of the river

This picture 6 shows the condition of the river upstream, it can be seen that there are many native varieties of the river, there is a canopy of vegetation that covers the river although it is not completely covered. the water conditions at this location are relatively shallow and have a relatively cooler temperature and the water conditions are also very clear. The low temperatures in rivers within the national park area are influenced by the canopy cover of riparian vegetation and the height of the river location (Magrima Anzani et al., 2016). There are many shredders in the upper reaches of rivers. Shredders and foragers are the main primary consumers in forested upper streams, providing the main link between organic inputs and predators (Graça et al., 2015); (Rosi-Marshall et al., 2016).

Similar to scrapers, the number of foragers is also high outside the upper reaches of the river. (Masese et al., 2014) reported that foragers were dominant in less canopy cover. There are foragers who have several special characteristics depending on their environment. The functional approach is based on easily recognizable morphological and behavioral traits of invertebrates that are directly related to their food acquisition methods (functional food groups or FFGs) (Ramírez & Gutiérrez-Fonseca, 2014).

The condition of the water current is quite strong, so that the oxygen content in the water is quite high, the presence of oxygen in the water can have a good effect on living creatures that live in the river. Canopy coverage and water flow velocity affect the size of organic matter which is a food source for macroinvertebrates. High water flow velocity increases oxygen in the water through diffusion (Pastore et al., 2019).

Result

Based on the analysis of data collected from observations, interviews, and written reflections of students, several key findings were found:

1. Improved Understanding of Theory through Field Practice, Most students reported that the visit to the Karangmumus River School helped them understand the concept of river ecology in more depth. Field conditions provide a real picture of the dynamics of river ecosystems, including the interactions between biotic and abiotic components and the impact of human activities on ecosystems.
2. Awareness of the Importance of Conservation, The results of the reflections showed that students became more aware of the importance of environmental conservation, especially in maintaining the function of river ecosystems. They realized that human activities, such as waste disposal and deforestation, have a significant negative impact on river health.
3. Emotional Involvement and Motivation, Students felt inspired by the efforts of the Karangmumus River School community in maintaining the cleanliness and sustainability of the river. This motivated them to get involved in similar activities, both on campus and in the local community.
4. Critique of Theory in Class, Several students noted that the field experience helped them see the limitations of the theory taught in class. They suggested that classroom learning includes more case studies and relevant real examples.

Figure 7. group photo after the forum group discussion activity with the speakers

The results of this study support the theory that experiential learning can improve students' understanding and awareness of environmental issues. In this context, visiting the Karangmumus River School provides a hands-on experience that is difficult to achieve through classroom learning. Integrating theory and practice through this field visit supports the creation of holistic learning. Students not only learn about river ecology theory but also understand the relevance of this knowledge in real life.

This study shows the importance of adopting experiential learning methods to improve environmental awareness. This model can be adapted to other environmental topics, such as forest conservation, waste management, and biodiversity protection. Thus, these results and discussion confirm that field experiences such as visits to the Karangmumus River School not only improve students' understanding but also motivate them to contribute to environmental conservation.

Discussion

The visit to the Karangmumus River School provided students with an in-depth understanding of river ecology through the River Continuum Concept (RCC). During the learning process, students not only grasped the theoretical aspects of changing ecosystem characteristics along the river flow but also directly observed real conditions in the field.

Through RCC, students analyze the relationship between physical, chemical, and biological parameters along the Karangmumus River. The results of the observations show that each part of the river has unique ecological characteristics, including river structure, biodiversity levels, and the condition of the river water itself. This aligns with the RCC principle, which illustrates the continuous ecological changes of rivers from upstream to downstream. Group discussions during the visit fostered students' critical thinking and collaborative skills. They compared field observations with RCC theory, identified factors influencing river ecosystem dynamics, and proposed conservation strategies tailored to local conditions.

However, several challenges were encountered during the activity, such as limited time for observation and insufficient supporting data for certain river segments. Despite these obstacles, the activity successfully strengthened students' competencies in understanding river ecology while enhancing their awareness of the importance of sustainable river ecosystem management. Thus, the RCC approach serves not only as a theoretical framework for comprehending river ecology but also as a tool to develop analytical skills and environmental consciousness among students.

Conclusion

This study shows that experiential learning through field visits to the Karangmumus River School significantly increases students' awareness of river ecology and environmental conservation. This activity allows students to:

1. Understand the concept of ecosystems and river ecology in more depth through direct observation of real conditions in the field.
2. Be aware of the negative impacts of human activities on river ecosystems and the importance of conservation efforts to maintain the sustainability of environmental functions.
3. Be inspired and motivated to play an active role in environmental conservation activities on campus and in the community.

The integration of classroom theory and field experience has proven effective in providing holistic learning. Therefore, this method is recommended to be applied in environmental education in order to create a younger generation who are more concerned and responsible for nature conservation, especially river ecosystems.

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